TITLE OF THE INVENTION

JUNCTION BOX AND CONNECTOR

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is based upon and claims the benefit of priority from the prior Japanese Patent Applications No. 2001-326149, filed October 24, 2001; and No. 2001-326155, filed October 24, 2001, the entire contents of both of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a junction box and a connector containing a connecting terminal for electrically connecting a fuse or the like to a wiring circuit. More particularly, the present invention relates to a junction box and a connector that are lightweight and low-profiled so as to promote the trend of down-sizing and allow to freely shift the point of connection with external wiring circuit, while showing a high heat emitting effect.

2. Description of the Related Art

In general, to branch a wiring of a car or the like, a junction box (J/B) has been used for purposes of space saving and cost reduction. FIG. 23 is a plan view of the junction box, FIG. 24 is a plan view of a bus bar contained in the junction box, FIG. 25 is a sectional view of a part VII of FIG. 23, and FIG. 26

is a sectional view of a part VIII of FIG. 23.

This type of a junction box 101 is constituted of a lower cover 102, a bus bar 103 attached to the lower cover 102, and an upper cover 105 which seals the lower cover and bus bar and to which a connector, fuse, and the like are attached. In the junction box 101, as shown in FIG. 24, the bus bar 103 formed, for example, of a pressed/punched metal plate of copper alloy, aluminum alloy, or the like is used to branch the wiring. Moreover, the junction box 101 also includes a function, for example, of a fuse box, when a fuse 107 is incorporated halfway in the wiring circuit constituted by the bus bar 103.

A connector 107 shown in FIG. 25 is a connector connected to the wiring circuit constituted of the bus bar 103. A connector 105a can be connected to the connector 107, when a connecting terminal portion 103a formed by bending a tip end of the bus bar 103 upwards by 90° is passed upwards through an upper cover 105 via a through hole 105b formed in the cover. Moreover, for a fuse attachment portion 105c to which a fuse 108 is attached as shown in FIG. 26, a connecting terminal portion 103d is formed by bending the tip end of the bus bar 103 with a slit 103b formed therein upwards by 90°, and is passed upwards through the upper cover 105 through a through hole 105d formed in the cover. Thereby, the connecting terminal portion can directly

be connected to a leg 108a for connecting the fuse 108, or can be connected using a so-called female to female (F-F) terminal.

Moreover, as shown in FIG. 27, the bus bars 103 and insulation plates (IP) 109 having functions of supporting and insulating the bus bars 103 are alternately superimposed to form a wiring circuit (multilayered wiring circuit) 110 which has a multilayered structure. A junction box 112 structured to contain the multilayered wiring circuit 110 in a housing for entirely protecting the outside of the circuit as shown in FIG. 28 is frequently used.

However, in the above-described junction box 101, the bus bar 103 is manufactured by punching the metal plate with a die and the wiring circuit is formed. Therefore, when the bus bars 103 having various shapes are manufactured, different dies are required, and much cost is taken. Moreover, the bus bar 103 is formed of a thick metal, a weight of the junction box 101 therefore increases, and there is a problem that it is difficult to thin the junction box 101. Furthermore, in the junction box 112, the number of layers of the multilayered wiring circuit 110 needs to be minimized in order to prevent the weight and cost of the entire junction box from increasing. Additionally, the multilayered wiring circuit 110 having a small number of layers is used in accordance with a connection mode.

For this, a circuit is drawn so as to avoid a wiring circuit of another layer and through holes 111 through which the connecting terminal portions 103a, 103d are passed, and a long circuit needs to be formed. This causes a problem that it is very difficult to lighten and thin the junction box 112.

Furthermore, since each of these junction boxes 101, 112 has a part thereof that is integral with it and on which a connector or a fuse is mounted, it inevitably shows certain dimensions and hence is subjected to certain restrictions particularly in terms of the position in a car where it is mounted. Additionally, since it has a structure in which the bus bar 103 is contained in a predetermined cabinet to make it show a rather poor heat emitting performance. Therefore, it is difficult to downsize the junction box and make is lightweight and lowly profiled particularly when it is to be used with a circuit adapted to allow a large electric current to flow. Furthermore, since the part on which a connector or a fuse is mounted is integrally formed with it, the operation of connecting the connector of an external wiring circuit to it will have to be carried out only poorly efficiently to baffle the efforts for improving the efficiency when the part, on which a fuse is mounted, is arranged on the front surface of the instrument panel of a car that is provided with a conventional junction box 101 or 112

for the purpose of improving the servicing efficiency.

BRIEF SUMMARY OF THE INVENTION

The object of the present invention is to provide a junction box and a connector that are lightweight and low-profiled so as to make themselves adapted to downsizing and show an enhanced level of freedom in terms of layout and a high heat emitting performance.

According to an aspect of the invention, the above object is achieved by providing a junction box comprising:

a junction box main body to which an electric component to be connected is attached; and

a cable portion which is constituted of a flexible printed circuit with a circuit portion including a conductor pattern formed on an insulating film, and electrically connects the junction box main body to an outer wiring circuit,

wherein the flexible printed circuit includes a strip portion having a part thereof contained in the junction box main body and a terminal connecting portion extending transversally from a lateral edge of the strip portion at a position to be fitted to the junction box main body,

the junction box main body includes a junction box housing provided with a part fitting port for fitting the electric component and a plate-shaped first connecting terminal to be contained in the junction

box housing so as to be connected to the terminal connecting portion of the flexible printed circuit and further to the electric component,

the junction box housing including a strip portion containing portion for containing a strip portion provided with the terminal connecting portion of the flexible printed circuit and a terminal containing hole arranged outside the strip-shaped containing portion containing portion so as to contain the first connecting terminal with its tip end exposed to the outside, and

the lateral edges of the strip portion are contained in the strip portion containing portion with the terminal connecting portion bent to show an S-shaped profile at the lateral edges of the strip-shaped containing portion of the flexible printed circuit.

Additional objects and advantages of the invention will be set forth in the description which follows, and in part will be obvious from the description, or may be learned by practice of the invention. The objects and advantages of the invention may be realized and obtained by means of the instrumentalities and combinations particularly pointed out hereinafter.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

The accompanying drawings, which are incorporated in and constitute a part of the specification,

illustrate presently preferred embodiments of the invention, and together with the general description given above and the detailed description of the preferred embodiments given below, serve to explain the principles of the invention.

FIG. 1 is a schematic perspective view of a first embodiment of junction box and connector according to the invention;

FIG. 2 is an exploded schematic perspective view of the cable portion;

FIG. 3 is a schematic partial cross sectional view of the junction box main body where the first connecting terminals are fitted to one of the junction box housings;

FIG. 4 is a schematic partial cross sectional view of the connector portion where the second connecting terminals and the strip portion are fitted to one of the connector housings;

FIG. 5 is a schematic partial cross sectional view of one of the connector housings to which second connecting terminals are fitted;

FIG. 6 is a schematic perspective view of another embodiment of junction box and connector according to the invention;

FIGS. 7A and 7B are schematic illustrations of the cable portion of the junction box of FIG. 6, showing its configuration;

FIGS. 8A through 8C are also schematic illustrations of the cable portion of the junction box of FIG. 6, showing its configuration;

FIGS. 9A through 9C are also schematic illustrations of the cable portion of the junction box of FIG. 6, showing its configuration;

FIGS. 10A and 10B are also schematic illustrations of the cable portion of the junction box of FIG. 6, showing its configuration;

FIG. 11 is a schematic partial cross sectional view of the junction box housing to which first connecting terminals are fitted;

FIG. 12 is a schematic partial cross sectional view of the one of the connector housings to which second connecting terminals are fitted;

FIGS. 13A and 13B are schematic illustrations of two alternative connector housings having different profiles, showing the connector portion in partial cross section;

FIGS. 14A and 14B are schematic plan views of an alternative junction box and a schematic plan view of another alternative junction box having an integral structure realized by utilizing the structure of the junction box of FIG. 14A;

FIGS. 15A and 15B are schematic perspective views of still another embodiment of junction box and connector according to the invention;

FIGS. 16A through 16D are schematic illustrations of various anchoring mechanisms that can be used for a junction box according to the invention;

FIGS. 17A and 17B are schematic lateral views of still another embodiment of junction box and connectors according to the invention, showing part thereof in cross section;

FIGS. 18A and 18B are schematic lateral views, showing grommets having different patterns;

FIGS. 19A through 19C are schematic illustrations of cable portions having different structures;

FIGS. 20A and 20B are schematic illustrations of cable portions having still different structures;

FIGS. 21A and 21B are schematic illustrations of instrument panels of automobiles provided with an embodiment of junction box and connector according to the invention;

FIGS. 22A and 22B are schematic perspective views of still other embodiments of junction box and connector according to the invention;

FIG. 23 is a schematic plan view of a known junction box;

FIG. 24 is a schematic plan view of a bus bar stored in the junction box of FIG. 23;

FIG. 25 is a schematic cross sectional view of a portion VII in FIG. 23;

FIG. 26 is a schematic cross sectional view of

part VIII in FIG. 23;

FIG. 27 is a schematic perspective view of a known wiring circuit having a multilayed structure; and

FIG. 28 is a schematic perspective view of a known junction box containing the wiring circuit having a multilayed structure;

DETAILED DESCRIPTION OF THE INVENTION

Now, the present invention will be described by referring to the accompanying drawings that illustrate preferred embodiments of the invention.

FIG. 1 is a schematic perspective view of a first embodiment of junction box and connector according to the invention.

The junction box 1 comprises a junction box main body 10, a connector portion 20 and a cable portion 30 connecting the junction box main body 10 and the connector portion 20. The cable portion 30 is formed by laminating a plurality of strip-shaped flexible printed circuits (to be referred to as "FPCs" hereinafter) 30a through 30d in a non-bonded state and bendable manner.

The junction box main body 10 includes a junction box housing 13, which is a resin molded member, and a lid body 16 removably fitted to the housing 13 and is arranged at an end of the cable portion 30. A plurality of fuse attachment portions 14 and a plurality of relay attachment portions 15 for

respectively attaching corresponding fuses 11 and relays 12 are formed in two rows in the longitudinal direction of the cable portion 30 on the surface the junction box housing 13 (that corresponds to the front surface of the junction box), which is same as the main surface of the group of FPCs 30a through 30d.

The connector portion 20 comprises connector housings 22a, 22b, which are resin molded members, and case portions 23a, 23b adapted to partly contain the connector housings 22a, 22b and can be divided in a thickness direction of the cable portion 30 and is arranged at the opposite end of the cable portion 30. The connector housings 22a, 22b include a plurality of connector engagement portions 25 into which respective plug connectors 21a, 21b are inserted.

FIG. 2 is an exploded schematic perspective view of the cable portion 30. While the cable portion 30 may be made to have a single FPC, superimposed upon one another in non-bonded state a plurality of FPCs in this embodiment.

Each of the FPCs 30a, 30b, 30c, 30d of the cable portion 30 comprises a circuit portion 32 produced by forming a pattern of a conductor material such as copper foil on a base film 31 typically made of insulating film of polyethyleneterephthalate (PET), polyethylenenaphthalate (PEN), polyimide (PI) or the like. If necessary, the circuit portion 32 is

protected by a cover layer (not shown).

Each of the FPCs 30a through 30d is provided at the lateral edges of the strip portion 33 thereof with a plurality of terminal connecting portions 34 having a predetermined length and extending transversally. The tip end of each of the terminal connecting portions 34 is connected to a metal-made and plate-shaped first connecting terminal 39a contained in the junction box housing 13 and constituting a part of the junction box main body 10 or a second connecting terminal 39b contained in the connection housing 22a (or 22b) and constituting a part of the connector portion 20. In this embodiment, the first connecting terminal 39a is a so-called fork terminal to be connected to fuses 11 and relays 12, while the second connecting terminal 39b is a so-called male connecting terminal to be connected to a female connecting terminal (not shown) of the plug connector 21a or 21b. Alternatively, the terminal connecting portions 34 may be arranged only at one of the lateral edges of the strip portions 33. The first and second connecting terminals 39a, 39b are provided with respective engagement holes 39c that are to be engaged respectively with lance mechanisms disposed in the junction box housing 13 and the connector housings 22a (or 22b) as will be described greater detail hereinafter.

The first and second connecting terminals 39a, 39b

are mounted respectively on the corresponding terminal connecting portions 34 so as to tightly adhere to the circuit portions 32 arranged on the terminal connecting portions 34 and bonded to the circuit portions 32 typically by means of resistance welding and hence to the terminal portions 34. After connecting the first and second connecting terminals 39a, 39b to the terminal connecting portion 34, the FPCs 30a through 30d are laid one on the other to produce a complete cable portion 30. Note that the terminal connecting portions 34 of the FPCs 30a through 30d are arranged in such a way that the first and second connecting terminals 39a, 39b are located at positions that properly correspond to the positional arrangement for connecting terminals of the junction box housing 13 and the connector housings 22a (22b).

After forming the cable portion 30 by laying the strip-shaped FPCs 30a through 30d, a resin molded portion 37 is formed and sealed by molding hot melt resin for the bonding portion of each of the connecting terminals 39a (39b) and the bonding portion of the corresponding connecting terminal portion 34 to improve the reliability of the connection of the bonding portions. Then, the first connecting terminals 39a are fitted to the junction box housing 13 while the second connecting terminals 39b are fitted to the connector housings 22a (22b). The terminal connecting portions

34 connected to the first connecting terminals 39a may be bent in such a way that the first connecting terminals 39a are housed in respective right terminal positions in the junction box housing 13, while they extend perpendicularly relative to the surface where the circuit portion 32 is formed in the cable portion 30. The terminal connecting portions 34 connected to the second connecting terminals 39b may not be bent at all.

FIG. 3 is a schematic partial cross sectional view of the junction box main body 10 where the first connecting terminals 39a are fitted to the junction box housing 13. FIG. 4 is a schematic partial cross sectional view of the connector portion 20 where the second connecting terminals 39b and the strip portion 33 are fitted to the connector housing 22a (or 22b).

As shown in FIG. 3, the junction box housing 13 of the junction box main body 10 has a plurality of terminal containing holes 24a, or terminal containing portions, for respectively containing the first connecting terminals 39a that are inserted into it with the exposed tip ends thereof and lance portions 26a, or lance mechanisms, to be engaged respectively with the engagement holes 39c of the first connecting terminals 39a so as to rigidly secure the first connecting terminals 39a in the junction box housing 13. The terminal containing holes 24a and the lance

portions 26a are arranged respectively at predetermined positions. The FPCs 30a through 30d of the cable portion 30 are contained in the junction box housing 13 with the surfaces thereof that form the circuit portions 32 arranged flat and the terminal connecting portion 34 bent in a perpendicular direction.

On the other hand, as shown in FIG. 4, the connector housing 22a (22b) of the connector portion (not shown) is provided with a connector engagement portion 25 for receiving connectors (not shown) of outer wiring circuits and the plug connector 21a (21b), a plurality of terminal containing holes 24b for respectively containing the second connecting terminals 39b that are inserted into it with the tip ends thereof projecting into the connector engagement portion 25, a strip-shaped portion containing portion 28 for receiving the FPCs 30a through 30d of the cable portion 30 in the direction of the lateral edges of the strip portion 33 with the terminal connecting portions 34 bent to show an S-shape profile and connected to the second connecting terminals 39b inserted into and contained in the respective terminal containing holes 24b and insertion holes 27 for receiving the second connecting terminals 39b and the cable portion 30 so as to insert them into the connector housing 22a (22b). In each of the terminal containing holes 24b (and hence outside the strip-shaped portion containing portion

28), a lance portion 26b, or a lance mechanism, to be engaged with the engagement hole 39c of the corresponding second connecting terminal 39b and rigidly securing the second connecting terminal 39b in the connector housing 22a (22b) is formed so as to extend from the inner wall side of the corresponding insertion hole 27 toward the inside.

The strip portions 33 of the FPCs 30a through 30d of the cable portion 30 are mostly contained within the connector housing 22a (22b) in such a way that the transversal direction a of the connector housing 22a (22b) rectangularly intersects the transversal direction b of the strip portions 33 of the cable portion 30. With this arrangement, the length HL that includes the length of the connector housing 22a (22b) and the width of the cable portion 30 can be minimized. A complete junction box 1 as shown in FIG. 1 is produced by fitting the cable portion 30 to the housings 13 and 22a (22b) and subsequently fitting the lid body 16 and the case portion 23 to the housings.

A connector housing 22a (22b) having connector engagement portions 25, terminal containing holes 24b, lance portions 26b and insertion holes 37 as shown in FIG. 5 may alternatively be used so that the strip portions 33 of the FPCs 30a through 30d of the cable portion 30 may not be mostly contained within the connector housing 22a (22b). If such is the case,

while the length HL is replaced by a longer length HL2 that is equal to the sum of the length of the connector housing 22a (22b) and the width of the cable portion 30, the connector portion 20 will still be satisfactorily downsized as it is sufficiently lightweight and low-profiled. Still alternatively, the junction box housing 13 may be made same as the connector housing 22a (22b) and the terminal connecting portions 34 of the cable portion 30 may be bent to show an S-shape profile to contain the strip portion 33 in a strip-shaped portion containing portion 28 formed in the junction box housing 13, although not shown in the drawing.

The first connecting terminals 39a and the second connecting terminals 39b can be made to conform to the profile of the junction box 1 by bending the terminal connecting portions 34 in a desired manner and shifting the positional arrangement of the connecting terminals 39a, 39b to a great advantage of improving the degree of design freedom. Then, it is possible to extremely reduce the height of the connector portion 20 shown in FIG. 1 if compared with conventional junction boxes to remarkably reduce the required space.

FIG. 6 is a perspective view showing the appearance of another junction box and connector according to the embodiment of the present invention.

A junction box 1' of this example is different

from the junction box 1 according to the above-described embodiment in that a cable portion 30' is branched into two in a superimposition direction of the FPCs 30a to 30d, two connector portions 20a, 20b are disposed on branched ends, and the fuse attachment portion 14 and relay attachment portion 15 of a junction box main body 10' are inserted into opposite side edges of the cable portion 30' from opposite sides in each row. In the embodiment, each of the connector portions 20a, 20b includes the connector engagement portion 25 only in one side edge of the cable portion 30'.

FIGS. 7A to 11B are diagrams showing the constitution of the cable portion 30' of this example.

First, as shown in FIG. 7A, the strip FPC 30a constituting a part of the cable portion 30' is constituted by disposing the patterned/formed circuit portion 32 on the base film 31 formed of the insulating film such as PET, PEN and PI. Additionally, as not shown, the cover layer is formed on the constitution if necessary. A plurality of terminal connecting portions 34 are formed to extend in the short direction of the strip portion 33 by the desired length from opposite side edges of the strip portion 33 of the FPC 30a. For example, first and second connecting terminals 39a, 39b having metal plate shapes are connected to the tip ends of the terminal connecting portions 34.

In this example, the terminal connecting portions 34 on one side are formed to be longer than the terminal connecting portions 34 on the other side. Additionally, the terminal connecting portions 34 may also be formed only on one side edge of the strip portion 33. Moreover, in the first and second connecting terminals 39a, 39b, the engagement holes 39c engaged with the lance mechanism disposed, for example, in a junction box housing 13a (13b) or the connector housing 22a (22b) are formed.

As shown in FIG. 7B, each connecting terminal 39a (39b) is disposed on the terminal connecting portion 34 so as to adhere to the circuit portion 32 on the terminal connecting portion 34. Thereafter, the terminal is subjected to the resistance welding by a pair of electrodes 38a, 38b of a series welding apparatus (not shown) allowed to abut on the terminal from above the connected portion with the circuit portion 32, bonded to the circuit portion 32 and connected to the terminal connecting portion 34. Additionally, since the resistance welding is a known technique, the description thereof is omitted. Additionally, the connecting terminal 39a (39b) may also be connected to the terminal connecting portion 34 by other methods such as ultrasonic welding, laser welding and soldering. When the terminals are connected to the portions in these connection methods,

a high connection reliability can be secured.

Subsequently, as shown in FIGS. 8A and 8B, the strip FPC 30a (30b) formed by connecting the connecting terminals 39a (39b) to the terminal connecting portions 34 in the method is superimposed to constitute the cable portion 30'. FIG. 8A is a top plan view showing the cable portion 30' constituted by superimposing the FPCs 30a, 30b upon each other, FIG. 8B is a partial side view of the cable portion 30', and FIG. 8C is a partial sectional view of the cable portion 30'. In this case, the terminal connecting portions 34 constituting the FPCs 30a, 30b constituting the cable portion 30' may be disposed and formed in the desired positions of the side edges of the strip portion 33 so that the connecting terminal 39a (39b) is disposed in a predetermined position corresponding to the connecting terminal arrangement position of the junction box housing 13a (13b) or the connector housing 22a (22b).

After a plurality of FPCs 30a, 30b are superimposed to form the cable portion 30' in this manner, as shown in FIGS. 9A to 9C, the connected portion of each connecting terminal 39a (39b) to the terminal connecting portion 34 is sealed by the resin molded portion 37. In this case, a certain number of connecting portions are collectively resin-molded at once as shown in FIG. 9A, the desired terminal arrangement state of the connecting terminals 39a (39b)

can be realized without separating bonding the strip portions 33 of the FPCs 30a, 30b having the non-bonded states. Moreover, since the strip portions 33 of the FPCs 30a, 30b are not attached, it is possible to flexibly move the respective FPCs 30a, 30b. FIG. 9A is a top plan view showing the cable portion 30' to which the resin mold is applied, FIG. 9B is a partial side view of the cable portion 30', and FIG. 9C is a partial sectional view of the cable portion 30'.

Additionally, as shown in FIG. 10A, for example, the terminal connecting portions 34 formed on one side edge of the strip portion 33 of the cable portion 30' formed in this manner are folded back on the side of the terminal connecting portions 34 formed in the other side edge. The terminal connecting portions 34 and connecting terminals 39a (39b) may also be disposed on one side edge of the cable portion 30' in a concentrated manner. As shown in FIG. 10B, for example, only the terminal connecting portions 34 formed on one side edge of the cable portion 30' to be contained in the connector portion 20a (20b) of the cable portion 30' may also be folded back toward the terminal connecting portions 34 formed on the other side edge to constitute the cable portion 30'.

When the terminal connecting portions 34 and connecting terminals 39a (39b) are arranged on one side edge, the entire height and width of the junction box can be

suppressed. When only some of the terminal connecting portions 34 and connecting terminals 39a (39b) are disposed on one side edge, as in the junction box 1' of this example, the height of one structure of the junction box main body 10' or the connector portion 20a (20b) is suppressed, and the connection is possible from an upward/downward direction in the other structure. Moreover, when the cable portion 30' in the state shown in FIGS. 8A and 8B is used, a width c of the junction box main body 10' and a width d of the connector portion 20a (20b) are reduced. In this case, a structure in which the connection from the upward/downward direction is possible both in the junction box main body and connector portion can be realized.

FIG. 11 is a partially sectional view showing that the first connecting terminals are attached to the junction box housings 13a, 13b of the junction box main body 10', and FIG. 12 is a partially sectional view showing that the second connecting terminals 39b are attached to the connector housing 22a (22b) of the connector portion 20a (20b).

As shown in FIG. 11, in the junction box housing 13a (13b) of the junction box main body 10', the terminal containing holes 24a through which the first connecting terminals 39a are passed and in which the terminals having tip ends exposed are contained, and

the lance portions 26a as the lance mechanism which are engaged with the engagement holes 39c of the first connecting terminals 39a and lock/fix the first connecting terminals 39a in both the junction box housings 13a, 13b are formed in the predetermined positions. The junction box housings 13a, 13b are locked by a lock mechanism (not shown). When the mechanism is unlocked, the housings can be vertically divided in the structure. The FPCs 30a, 30b constituting the cable portion 30' are contained in the junction box housings 13a, 13b while the surfaces with the circuit portions 32 formed thereon are longitudinally disposed and the terminal connecting portions 34 are extended as such from the opposite side edges.

On the other hand, as shown in FIG. 12, in the connector housing 22a (22b), there are formed: the connector engagement portion 25 which is engaged with the connector of the outer wiring circuit; a plurality of terminal containing holes 24b through which the second connecting terminals 39b are passed and in which the terminals having the tip ends projected in the connector engagement portion 25 are contained; and the insertion hole 27 into which the cable portion 30' having the second connecting terminals 39b passed through the terminal containing holes 24b is inserted in the side edge direction of the strip portion 33.

In a plurality of terminal containing holes 24b, the lance portions 26b, engaged with the engagement holes 39c of the second connecting terminals 39b, for locking/fixing the second connecting terminals 39b in the connector housing 22a (22b) are formed. The terminal connecting portions 34 of the FPCs 30a, 30b constituting the cable portion 30' are contained in the insertion hole 27 in the connector housing 22a (22b) so that the terminal connecting portions constitute the predetermined connecting terminal arrangement positions in a state shown in FIG. 12. Additionally, since a cover layer 30a1 is disposed on the circuit portion 32 of the FPC 30a, the circuit portion is structured not to have a short circuit with the circuit portion 32 of the folded-back terminal connecting portion 34 of the FPC 30b.

With the above-described attachment structure of the connecting terminal 39b to the connector housing 22a (22b), as shown in FIGS. 13A and 13B, when the connector housing 22a (22b) is just replaced with a housing having a different shape, the connector portion 20a (20b) can inexpensively be realized in accordance with various connector shapes. For example, a height h1 of an outer wall constituting the connector engagement portion 25 of the connector housing 22a (22b) shown in FIG. 13A is different from a height h2 of the outer wall constituting the connector engagement

portion 25 of the connector housing 22a (22b) shown in FIG. 13B. Therefore, without changing the fold-back modes of the connecting terminals 39b and terminal connecting portions 34, cable portion 30' and case portion 23a (23b), it is possible to connect the connectors (outer connectors) of different types of outer wiring circuits, plug connectors 21a, 21b, and the like in accordance with the respective heights h1, h2. Thereby, it is possible to provide the junction box 1 for various connectors while the cost is suppressed.

Additionally, the junction box 1 of this example includes a structure in which the junction box main body 10' is connected to the first and second connector portions 20a, 20b via the cable portion 30' including a plurality of flexible strip FPCs 30a to 30d. Therefore, as shown in FIG. 14A, of course, the junction box main body 10' and the connector portion 20a (20b) may be formed with different housings and connected to each other so that the respective housings can freely be moved via the cable portion 30'. Moreover, as shown in FIG. 14B, the junction box main body 10' and connector portion 20a (20b) are arranged in one housing 36, the cable portion 30' is contained in a connecting state of the junction box main body 10' to the first and second connector portions 20a, 20b in the housing 36, and a junction box 1" having

an integral structure may be formed. When the cable portion 30' having flexibility is used, various types of junction boxes having different shapes can easily be realized at a low cost.

Moreover, not only the integral structure shown in FIG. 14B but also an integral structure shown in FIGS. 15A and 15B may be used.

FIGS. 15A and 15B show perspective views of the appearance of the junction box according to another embodiment of the present invention.

That is, in the integral structure of this example, as shown in FIG. 15A, a junction box 1A in which a junction box main body 10A is connected to a connector portion 20A via a cable portion 30A is integrally fixed via a fixing mechanism 70 (70a, 70b) disposed in predetermined positions of the junction box main body 10A and connector portion 20A. The fixing mechanism 70 includes hooks 70a formed on a part of the lower surface of the junction box main body 10A, and hook engagement portions 70b formed in a part of a side part of the connector portion 20A. FIG. 15B shows that the hooks 70a formed on the junction box main body 10A are inserted in the hook engagement portions 70b formed in the connector portion 20A and both the main body and connector portion are integrally locked/fixed. As the fixing mechanism 70, for example, mechanisms shown in FIG. 16 are considered.

That is, as shown in FIGS. 16A and 16B, a metal bracket 40 is formed on the side surface of the housing or the case portion of either the junction box main body 10A or the connector portion 20A by an insert mold. A bracket engagement portion 41 to be engaged with the metal bracket 40 is formed in the side surface of the other housing. When the bracket is engaged with the bracket engagement portion, the junction box main body 10A and connector portion 20A are fixed by this fixing mechanism.

Moreover, as shown in FIG. 16B, a so-called anchor clip 42 is formed on the side surface of either one housing of the junction box main body 10A or the connector portion 20A by integral molding. An anchor clip fixing portion 43 including a hole to be engaged with the anchor clip 42 is formed in the side surface of the other housing. The anchor clip 42 is inserted in the anchor clip fixing portion 43 so that the junction box main body 10A and connector portion 20A are fixed by this fixing mechanism.

Furthermore, as shown in FIG. 16C, a rib 44 having a T-shaped section is formed on the side surface of one housing of either the junction box main body 10A or the connector portion 20A by the integral molding. A rib fixing portion 45 including a trench structure into which the rib 44 is slid, inserted and engaged is formed in the side surface of the other housing.

The rib 44 is inserted into the rib fixing portion 45, and the junction box main body 10A and connector portion 20A are fixed by the fixing mechanism.

Additionally, as shown in FIG. 16D, a fixing protrusion 46 is formed in any one of the junction box main body 10A and connector portion 20A, and a lock piece 47 to be engaged with the protrusion 46 is formed in the other one. The protrusion is engaged with the piece so that the junction box main body 10A and connector portion 20A are fixed by the fixing mechanism. When these above-described fixing mechanisms 70 are formed beforehand in the housings of the junction box main body 10A and connector portion 20A, the modes of the junction box 1A including an independent structure and integrally coupled structure can easily be selected in a design stage. This makes it possible to enhance a freedom degree of layout of the junction box 1A. Additionally, other various fixing mechanisms for fixing the junction box main body 10A and connector portion 20A are considered, but the description thereof is omitted here. Moreover, needless to say, the above-described fixing mechanism 70 may also be used to fix a plurality of formed connector portions to one another.

FIGS. 17A and 17B show a side view and partially sectional view showing the junction box according to still another embodiment of the present invention.

As shown in FIG. 17A, a junction box 1B includes a structure in which the junction box main body 10 is connected to the connector portion 20a (20b) via the cable portion 30 (not shown), and the exposed portion of the cable portion 30 from the junction box main body 10 and connector portion 20a (20b) is covered with a grommet 48B. As shown in FIG. 17B, the grommet 48B is formed of the above-described materials such as silicon rubber and ethylene propylene rubber (EPDM), has high flexibility and durability, and therefore constitutes a so-called bellows shape. Opposite ends 48a of the grommet 48 have engagement structures engaged with opening peripheral edges 48b of insertion ports of the cable portion 30 into the junction box main body 10 and connector portion 20a (20b), and are attached/fixed to the junction box main body 10 and connector portion 20a (20b). The grommet 48B attached in this manner can effectively prevent the moisture and dust from entering the junction box main body 10 and connector portion 20a (20b) as described above, and can effectively protect the circuit portions 32 of the respective FPCs constituting the cable portion 30 in the exposed state between the main body and portion from damage and breakage. Therefore, the durability of the junction box 1B can be enhanced.

Additionally, for the grommet 48B, instead of the bellows shape, for example, a tubular shape including

the above-described square section (rectangular section), or a cylindrical shape including a circular shape may be used as shown in FIG. 18A. Moreover, when it is unnecessary to cover or protect the exposed portion of the cable portion 30, as shown in FIG. 18B, the grommet 48 engaged with the opening peripheral edges 48b of the insertion ports of the junction box main body 10 and connector portion 20a (20b) and constituted as a packing for effectively closing the insertion ports and preventing the entrance of the moisture may be used to constitute the junction box 1B.

Additionally, as the above-described cable portion 30, as shown in FIGS. 19A to 19C, a cable portion 30B may also be used including a structure in which the strip portions 33 are folded back and superimposed in order to shorten a circuit width e of the circuit portion 32. In this case, for example, as shown in FIG. 19A, a center line 33a is determined which connects the vicinity of the center of the short direction of the strip portion 33 of the FPC 30a constituting the cable portion 30B in the longitudinal direction. As shown in FIG. 19B, the strip portion 33 of the FPC 30a is bent and superimposed along the center line 33a so that the surfaces with the circuit portions 32 (or the surfaces with the base film 31) formed thereon are disposed opposite to each other. As shown in FIG. 19C, the FPC 30a is superimposed onto

the FPC 30b with a strip portion 33' formed beforehand thereon with a circuit width which meets a circuit width e' of the folded FPC 30a, and the cable portion 30B is formed. When the entire circuit width of the cable portion 30B is reduced in this manner, the entire height and width of the junction box 1 applying this cable portion 30B can be suppressed, and the junction box 1 can efficiently be miniaturized. Moreover, the FPC 30a having the folded strip portion 33 is set beforehand, for example, in a power supply circuit (power distribution circuit). As a result, a circuit area can be enlarged. Therefore, the FPC which has high radiating properties and whose circuit width can be adapted to the circuit width of another FPC or shortened can be used as the power distribution circuit.

Moreover, as shown in FIG. 20A, the FPCs 30a, 30b constituting the cable portion 30B are first superimposed upon each other. Thereafter, the strip portions 33 of the respective FPCs 30a, 30b are folded so that the center line 33a of each strip portion 33 is positioned in the vertical direction with respect to the circuit formed surface of the circuit portion 32 (so that the center line is a bottom side of a portion folded in a trough shape or an apex of a portion folded in a mountain shape). As shown in FIG. 20B, a part of the folded strip portion 33 is further folded, and the

cable portion 30B having a short circuit width may also be realized.

Additionally, the junction box 1 of the present invention is used in a mode in which the junction box main body 10 is connected to a plurality of connector portions 20 in independent states via the cable portion 30. In this case, for example, an application method shown, for example, in FIGS. 21A and 21B can be realized. That is, FIGS. 21A and 21B show diagrams of a state in which the junction box 1 is disposed in an instrument panel of a car, FIG. 21A shows the instrument panel for use in a so-called right-side steering wheel mounted car, and FIG. 21B shows the instrument panel for use in a so-called left-side steering wheel mounted car.

For example, with an instrument panel 50a of the right-side steering wheel mounted car shown in FIG. 28A, and an instrument panel 50b of a left-side steering wheel mounted car shown in FIG. 21B, the arrangement position of the junction box main body 10 is set in the vicinity of a steering wheel. The first connector portion 20a is disposed on the right as facing the instrument panel 50a or 50b and the second connector portion 20b is disposed in the middle of the instrument panel 50a or 50b. Then, the arrangement position of the connector portion 20a (20b) can be set in common to the right and left side steering wheel

mounted cars. Therefore, a common harness can be used, the number of components can be decreased, and the cost can be reduced. As described above, according to the arrangement structure using the junction box 1, the attachment positions of the junction box main body 10 and connector portion 20a (20b) can easily be changed, and the arrangement positions can freely be determined. Therefore, a large design change is not accompanied. Even in this case, it is possible to enhance the freedom degree of layout and broaden wiring design, and the like.

Additionally, in the above-described embodiment, several examples of the mode of the junction box 1 have been described, but the present invention is not limited to these examples. Examples of the mode include various modes of junction boxes such as: a junction box 1C constituted of a combination of a junction box main body 10C, connector portion 20a (20b) and cable portion 30C as shown in FIG. 22A; and a junction box 1D constituted of a combination of a junction box main body 10D, connector portion 20D and cable portion 30D as shown in FIG. 22B.

Additional advantages and modifications will readily occur to those skilled in the art. Therefore, the invention in its broader aspects is not limited to the specific details and representative embodiments shown and described herein. Accordingly, various

modifications may be made without departing from the spirit or scope of the general inventive concept as defined by the appended claims and their equivalents.